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No. 671

TWELFTH RHÖN SOARING CONTEST, 1931

By Walter Georgii

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The Twelfth Rhön soaring competition formed the fitting conclusion of a period of gliding activities never seen before. Throughout the months from spring until midsummer the gliding enthusiasts were much in evidence in all parts of Germany, trying for the Hindenburg Glider Prize. Competition was benefited considerably by the general introduction of the towing glider in the spring of the year. Towed aloft by airplane, it made every landing field amenable for performance gliders which heretofore had been restricted to certain localities. Groenhoff's flight from Munich to Kaaden (Bohemia), an air-line distance of 275 km (171 mi.), in particular, had left a lasting impression of the great advantages of towing gliders. Groenhoff and Riedel's excursion by towed glider to Munich led others to undertake similar flights. It was soon followed by the thermic gliding experiments of Otto Fuchs in Berlin, which culminated in a flight from Berlin to Frankfort on the Oder, a distance of 80 km (50 mi.), by Kronfeld's flights in England, whose greatest achievement, apart from his spectacular channel flight, consisted of a thermic gliding flight from London to Chatham, by Hentschel's 11½-hour flight at Dörnberg near Kassel, and by Dinort's record of 11 hours and 39 minutes at Rossitten.

Part of the newer research problems embarked upon last year was the glider expedition into the high Alpine region of the Jungfrau in Switzerland. The crew of the "Fafnir" - Groenhoff, Riedel, and Harth - was given an excellent opportunity for collecting first-hand data as to the usefulness of gliders in the Alps. It is necessary to recount the remarkable glider achievements ahead of the Rhon Soaring Contest, in order to understand the tension and expectation with which the Rhön Contest was anticipated.

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*"Ergebnisse des 12. Rhön-Segelflug-Wettbewerbes 1931." From Zeitschrift für Flugtechnik und Motorluftschiffahrt, Feb. 29, 1932, pp. 97-102; and March 14, 1932, pp. 125-132.

The great many new gliders of groups making their first appearance on the Rhön, and the astonishing number of juvenile flyers with C certificates, prove that the numerous local contests in various parts of the country constitute an excellent preliminary training for sailplane contests. In spite of the extremely precarious economic conditions, 59 sailplanes were entered, of which 49 appeared at the field.

The former method of grading the entries into schooling practice and performance was retained in principle, even though the gliding contest was eliminated. For, according to the experiences from the 1930 contest, it was found that a certain classification into junior, advanced, and master groups was absolutely necessary - the first two categories being admitted to the "practice" contest only and comprising the pilots having but lately (a few months before) received their C license and not having made any duration flights of more than 5 hours, or those who had not flown since 1928. The official certificate with 5 sailplane flights of altogether 30 minutes' duration, was necessary to qualify the entrant for the "performance" contest. This method of grading has proved eminently satisfactory.

Another significant fact revealed by the Contest was that precisely the juvenile flyers had, in many cases, not enough experience to fly performance gliders, and the result was that many a promising looking craft was crashed during the first few days.

The rules governing the "practice" contest were closely patterned after the previous meets; that is, primarily, duration and altitude. The duration was rated, as in former years, for total flight duration, and in two categories: Juniors without experience, and juniors having more than one hour's experience.

The winners of the "practice" contest for total duration, according to this rating, were the "Württ. Luftfahrtverband" under the leadership of Kunzer and Hakenjos, and the glider of the "Arbeitsgemeinschaft Wurzburg" with Schmid and Endres as pilots, whereas the winners of the altitude total were W. Teichmann, Berlin, the "Akaflag Marcho-Silesia" (pilot Pfeiffer), and again the "Wurtt. Luftfahrtverband" (pilot Hakenjos). In 1930 the total of the "practice" contest for greatest total flight duration was 27 hours and 28 minutes; this year it totaled 9 hours

less, which, however, is not to be interpreted as regressive. The best proof of the never-fading zeal and eagerness, particularly within the ranks of the juvenile group, is the large number of flights made, namely, 300 actual flights as against 132 starts in 1930. The main reason for the smaller total duration and the considerably less maximum duration of the individual flights is traceable to the peculiar weather conditions. West-slope weather with amply strong, continual west winds, so typical of the 1930 contest, was altogether lacking except for a very few days.

During the entire second half of the contest in particular, the conditions were altogether abnormal under the influence of extremely bumpy, easterly winds. They especially proved a drawback for the duration flights. Besides, the upwind zones on the slopes facing south and east are very narrowly restricted and several gliders in the air at the same time interfere with, if not actually endanger one another. In spite of this, Schmid, of the "Arbeitsgruppe Würzburg," made an exceptionally beautiful flight. He attempted, on July 28, to break the Rhon endurance record with the "Würzburger Generalanzeiger." Although wholly unprepared, he decided to stay aloft as long as possible, but was finally forced to land after exactly 9 hours, because of rain and complete abatement of the wind. Hemmer's 1930 record of 9 hours and 36 minutes was not beaten.

Against this showing of the junior group, that of the advanced flyers during the "practice" contest fell surprisingly short. Of the eight entries, not one passed the minimum requirements of the prize rules.

Although there was not as much flying as usual because of the weather conditions, the days of the west winds were that much more eagerly taken advantage of, and many beautiful flights were made, notably the squadron flight on July 28. With Groenhoff in the lead, seven juvenile flyers received their initiation into the secrets of cloud sailing. It was a beautiful spectacle to watch the youngsters imitate every curve of their leader, and three planes, in fact - the "Offermann" (Teichmann, pilot) with 34.6 km (21.5 mi.), the "Professor" (Hakenjos, pilot) with 29.8 km (18.5 mi.), and the "Stadt Stuttgart" (Kunzer, pilot) with 24.8 km (15.4 mi.) were able to qualify for the consolation prize.

The chart (fig. 1) shows four groups of preferred flight directions. The first and most extensively used is from the Wasserkuppe past the Hohe Rhön northward toward the Ochsen and Vacha. It is the favorite "Nehring" route of 1927 and 1928, so popular with the younger groups because of its favorable upcurrents.

The second is eastward from the Wasserkuppe over the Hohe Rhön toward the Geba. The majority of gliders followed this route in the storm-front flights of July 25 and August 3. Altogether different from the normal front thunderstorms out of the west, this storm of August 3, rose out of the east. It most likely had the character of a more local heat thunderstorm. No effective frontal upcurrent was ascertained. As a result, all the gliders had to land again in the neighborhood of the Wasserkuppe. These landings form the third intermediate group in Figure 1.

The fourth group is toward the east and the river Fulda. Botsch covered this route of 19 km (11.8 mi.) in 1923, the last time. The altogether abnormal east winds during the second half of this year's contest forced the flyers into this direction for the first time in 8 years. These east winds, which at first threatened to become disastrous, subsequently proved to be of great value, inasmuch as they turned the contest into entirely new channels and enhanced the possibilities of thermic sailing. The most prominent distance and altitude flights of the performance race are appended in Table II.

The rules governing the prize for reaching a prescribed destination, run off every year during the performance race, were much more exacting this year than heretofore. Whereas last year's rules stipulated a flight of 15 km (9.3 mi.) to the Kreuzberg and return to the Wasserkuppe, this year's rules called for a flight with the Ochsenberg near Vacha, a distance of 34 km (21 mi.), as destination. The flight with fixed destination thus became more than 68 km (42.3 mi.) with start from and return to the Wasserkuppe. The flight to the Ochsen was a comparatively easy stretch, whereas the lap, Rhon - Wasserkuppe was very difficult. The last 10 km, especially, from the Hohe Rhon to the plateau of the Wasserkuppe, through the downwind zone of the Wasserkuppe, presumes high-flying altitude, which can only be attained by cloud-up wind on the Hohe Rhön. It was foreseen that this last stretch near the goal would call for extraordinary skill,

and for that reason the rules did not specify a return to the plateau of the Wasserkuppe, but merely a landing anywhere at the foot, providing the distance did not exceed 1500 m (4920 ft.) from the top. The prize was not contested. Hirth and Groenhoff almost qualified for the entrance rules by landing 1000 m (3281 ft.) and 1500 m (4920 ft.), respectively, outside of the prescribed 1500 m radius. The flight put up by Hirth, Groenhoff and Kronfeld to complete this race victoriously, was almost dramatic. Again and again Hirth and Groenhoff tried before they finally effected a landing within the radius cited above. "The efforts of both flyers to push on from the Hohe Rhön to the Wasserkuppe, to overcome this last but most difficult lap, were an exciting fight for every meter of altitude. Groenhoff's attempt, in particular, to obtain a last ounce of upwind by skimming the tree tops, and Kronfeld's three-time return to the Wasserkuppe for a new start was a spectacular and gripping sight. These flights of Kronfeld for the Öchsenberg prize, one of which lasted over seven hours, are new proof of the remarkable stamina and will power of this pilot.

But the features which place this year's race at the head of all previous ones, are: the unique front sailing flight by a squadron of 12, on July 25, in the face of an approaching storm; Groenhoff and Hirth's 220 km (136.7 mi.) and 175 km (108.7 mi.) flights to Magdeburg and Halle; further, the first thermic sailing flights of over 100 km (62 mi.), namely, Hirth's 192 km (119.3 mi.) to Brohl on the Mosel, Kronfeld's 165 km (102.5 mi.) to Arnsberg on the Westfalen, and Groenhoff's 107 km (66.5 mi.) to Bad Nauheim. It is necessary, in order to appreciate and clearly understand these flights, to treat them in connection with an explanation of the scientific principles of thermic sailing flight.

The prevalence of ascending convection currents in the free atmosphere is contingent upon the local overheating of detached air masses above a given, thermically favored territory, or upon the liberation of diffused atmospheric instability, which is produced by regional overheating of the nethermost air strata or cooling off at some height. The escape of this instability, manifested by excessive vertical temperature gradient, is brought about by the rise of detached quantities of air, whether orographic by slope updraft, frontal by frontal upwind, or turbulent by vertical displacement of air masses in turbulent layers. The ascending convection current becomes

a cloud upcurrent when air masses are elevated beyond their height of condensation by any of these three methods of escape, and attain new buoyancy and acceleration by the heat of condensation set free through cloud formation. The cloud upcurrent has, in contrast to the thermically rising, dry air masses without forming clouds, the advantages, as far as sailing flight is concerned, of greater vertical extent, greater vertical velocity and lastly, of being more readily recognized. For that reason it becomes readily apparent why thermic sailing flight in cloud upwinds preceded the utilization of upcurrents without clouds or "invisible" thermic upwinds. For the evaluation of the latter, the so-called "emagram" (energy-mass diagrams, according to Refsdal*) has proved extremely valuable. The emagram gives a direct representation of the energy mass necessary for an air mass to enable it to execute free vertical movements. To illustrate, take the state of the atmosphere on July 28, 1931 - the day of the squadron flight in the cloud upwind: If T is the temperature of air vertically at rest, T' the temperature of the dry adiabatic of an isolated, dry air mass rising from the ground, T" the temperature of the same air mass on the damp adiabatic after inception of condensation, then the difference $T' - T$ and $T'' - T$, the so-called dry, unstable or damp, stable temperature difference is a criterion for the acceleration of the ascending air. According to the emagram of July 28 (fig. 3), an adiabatic temperature gradient prevailed that day in the lower strata up to 1500 m (4920 ft.). An ascending air mass on the Wasserkuppe thus was in thermic equilibrium with the surrounding air at any height. The upward motion of the air rising on the slope was not thermically retarded and thus enabled to reach its condensation level. Between 1500 and 1600 m (4920 and 5250 ft.) is a minor, negatively dry, unstable temperature difference. But since this layer is restricted in height and the negative temperature difference between ascending and surrounding air is slight, the air rising on the mountain is able to push through this layer and into the upper, markedly damp, unstable strata. After inception of condensation the rising air masses are warmer as the height increases than the surrounding air which is vertically at rest. As a result the cloud air is speeded up on its upward passage and the cloud upwind within the cloud itself grows with increasing height.

Refsdal, A.: The Moist Unstable Precipitation. Geofysiske Publikationer, Vol. V, No. 12, Oslo, 1930.

Particularly favorable thermic upcurrent conditions prevailed in the second half of the contest, during the long spell of warm east-wind weather, as seen from the appended emagrams. The gentle southeast wind on August 1, was unsuited for slope sailing, but eminently fitted for essaying thermic sailing flight with towed sailplane. The research institute of the R.R.G. had offered a special prize for towed flight on light-breeze days, so as to give less experienced groups a chance of becoming familiar with towing start methods. On the afternoon of August 1, pilot P. Riedel towed nine sailplanes into the air. Released at 500 m (1640 ft.), Groenhoff in "Fafnir" stayed aloft 1 hour and 42 minutes; Hirth in "Musterle," 1 hour and 37 minutes; and Kronfeld in "Wien," 1 hour and 10 minutes. The emagram for this day augured extremely propitious conditions for the formation of convection currents. By a dry-unstable state up to 2000 m (6560 ft.), air masses, risen orographically on the Wasserkuppe, were free to push on and upward. (Fig. 4.) From 2000 m on, the air was damp-unstable, so that air masses risen to this height could continue to rise as cloud-upwind as soon as condensation began. The ascent continues up to 2400 m (7874 ft.), where a strong temperature inversion forms an effective intercepting layer. And Groenhoff's, as well as Hirth's flight are in perfect accord with these theories. After unhooking from the airplane, Groenhoff soared along the east slope of the Wasserkuppe till the released slope current had changed into a free, ascending warm air current topped by a cumulus cloud, and in this convection current he gradually circled to greater height. It is a characteristic of the ascending convection currents formed from slope upwinds that their upwind zone from the windward slope shifts more and more with the general wind toward the leeward side, whereby the free upcurrent very often does not attain its greatest strength until it reaches the leeward side, with the result that in the lee above downward-slope currents the ascending convection current is particularly powerful. This is well illustrated by Hirth's and Groenhoff's flights. (See figs. 5 to 8.) In excellent agreement with the theory of vertical expanse of ascending convection currents, Groenhoff reached a maximum absolute ceiling of 2300 m (7545 ft.), and Hirth's route was very much like it. (See figs. 5 and 6.) Hirth's flight was also mainly made on the west slope of the Wasserkuppe despite the east winds, and this flight likewise revealed the previously mentioned phenomenon that the unstable energy set free on the windward slope of the mountain as a result of forced rise of the air, shifts the strongest ascending convection currents far to leeward.

On August 2, the thermic conditions on the Wasserkuppe were practically the same as the day before. The atmospheric instability was even higher. Up to 1900 m (6234 ft.), the air was markedly dry-unstable, beyond it and up to 2200 m (7218 ft.) damp-unstable where, as on the previous day, a strong temperature inversion formed an effective barrier. The entirely successful flights of Pfeiffer, in his excellent "Schlesien in Not" were a revalation to the spectators. Taking advantage of the brisk east wind, he flew the little explored east slope of the Eube and, to the astonishment of all, reached a height of 800 m (2625 ft.) in very little time.

His example was immediately followed by the other enthusiasts. The heights attained in the "practice" and "performance" contests as compiled in Tables I and II were practically all made that day. Groenhoff and Hirth utilized the favorable thermic conditions prevailing that date for the first distance sailing flights into West Germany. Groenhoff landed after 107 km (66.5 mi.) at Laubach near Bad Nauheim; Hirth crossed the river Rhine, and landed at Brohl on the Mosel, after covering a distance of 193 km (120 mi.).

This rapid development of ascending convection current sailing is due in a large measure to the towing of gliders. It makes it possible to develop a systematic method of thermic sailing flight, which stipulates that the pilot must utilize as long as possible every indicated free upwind zone (whether by feel, or better, indicated by sensitive variometer) by continuous circling in the zone. During this circling the pilot must attempt to attain the height which enables him to continue until he finds a new upwind zone. When the ascending convection currents rise beyond the height of condensation, the cumuli serve as guideposts to new upcurrents. In the absence of clouds the pilot must rely on his "feel" or his variometer, in order to orientate himself as to location, expanse and strength of the "invisible" ascending air masses. This method of thermic sailing flight was explored by the remarkable French glider enthusiast, P. Idrac, in several expeditions to North Africa in 1919-1923.* Pursuing different methods the research institute of the R.R.G. uses sounding balloons. An example of such records is given in Figure 11.

The utilization of ascending convection currents was heretofore handicapped by the question of frequency. Long-

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Idrac, P.: Experimental Studies on Sailing Flight. Librairie des sciences aéronautiques, Paris, 1931.

distance flights by the sole use of thermic upwind zones without cloud formation are possible only when thermic upcurrents are frequent enough so that the pilot can feel confident of even accidentally finding the most usually invisible upwind zones which are far from being local conditions. In this respect, Kronfeld's flight on the afternoon of August 5, from the Wasserkuppe to Arnsberg (Westphalia), a distance of 165 km (102.5 mi.) is worthy of note.

On this particular day the atmospheric conditions were somewhat different than on the other days. According to the emagram the air was dry-unstable up to 1500 m (4920 ft.); from there to 2000 m (6560 ft.) the stratum was neutral - in part, stable. Beginning at 2000 m, the air became increasingly damp-unstable. The sky was almost cloudless. In the east, far from the Wasserkuppe, perhaps on the Thuringer Wald, a few cumuli could be seen. The escape of the instability of the atmosphere in the ambit of the Wasserkuppe was therefore restricted to the lower dry-unstable strata. It evidently lacked the impulse to release the damp instability of the upper layers. As a result the convection current was confined to the strata below 1500 m. The cloud upwind of the layers above 2000 m failed to release that day. Since the horizontal wind velocity did not exceed 5 m/s, it was extremely difficult to connect with the ascending convection currents. Only Kronfeld made a serious attempt, and even though the "Wien" was superior to others as far as sinking speed is concerned, he had great difficulties in keeping in the slope upcurrent. He flew for over an hour, at times very low, on the slope of the Eube trying to gain altitude. At times it seemed hopeless, but after one hour he was able to get high enough above his starting height, to rid himself of the slope and connect with the free ascending convection currents. His subsequent method of flight was again a masterly exhibition of the art of sailing flight and a classical example of thermic sailing, a fitting sequence of his earlier flights - his Himmeldankberg flight in 1928, and his 140 km (87 mi.) flight to Bad Hermsdorf in 1929. A glance at Figure 13 shows how Kronfeld, after leaving the slope of the Wasserkuppe, gained altitude after finding a convection zone. About 10 km (6.2 mi.) away from the slope, he was 600 m (1969 ft.) above his starting point. A section of the barogram of this flight (fig. 14) is the best proof of his skill and resourcefulness. Ascent and descent follow one another with almost wavelike regularity. Rising, he circled in the found upwind zone, descending he endeav-

ored to locate a new upwind zone, always maintaining his course in the direction of the wind, so as to cover distance at the same time. He stayed aloft over six hours. Toward evening the intensity of the convection currents abated and he landed 165 km (102.5 mi.) away, at Arnsberg (Westphalia).

Aside from Kronfeld's feat, this flight offered the first important scientific information about the frequency of ascending convection currents. The flight proved that finding convection currents in sailing flight can actually be left to chance, because they apparently are so plentiful if the weather is favorable and the sailplane has enough altitude that a short gliding flight again leads to an effective upwind zone. For the rest, Kronfeld's flight indicates that the dependence of the ascending convection currents on the surface conditions of the ground (fields, woods, meadows, water, etc.) is not general, and may even be of a secondary nature. The systematic sequence of the upcurrents, manifested in the barogram, is not indicative of any marked dependence of the convection current on the surface conditions. It even appears possible that the certainly remarkable wavelike sequence of the upwind zones is not accidental, but rather contingent upon a certain systematic disposition of the vertical rearrangement of the unstable air masses.

Thermic sailing flight finds its greatest development in subtropical and tropical countries. It is entirely feasible that in such countries, gliding may even attain real practical significance. It is for this reason that the International Study Committee for engineless flight, laid particular stress upon exploration of thermic sailing flight in the tropics, during its October session in London.

The main feature from the sports standpoint, of the whole contest, was, without a doubt, the unique storm flight of July 25. The sound of the siren notified the contestants of the approach of a storm front. Before its arrival the wind was from the south. Everybody awaited eagerly the shift of the wind to the west. At the instant the wind changed the first machine started, eleven others following in quick succession within seven minutes. It was a sight never to be forgotten. The singleness of purpose and the cheerful enthusiasm with which even young pilots who had not learned as yet the secrets of storm-front sailing, took off for the heavy clouds amid thunder

and flash of lightning and the subsequent thick sheet of rain, were astonishing. Those not cognizant of the familiarity of the sailing-flight pilot with clouds or wind, may have looked upon this start as foolhardy, daring, but the end of the flight proved that the pilot has ample presence of mind to entrust himself to the storm only so far and so long as it is of advantage for him to do so. A great number of the younger flyers were unable to accompany the storm front for more than 30 km (18.6 mi.). Röhm in the "Stadt Stuttgart" followed for 38 km (23.6 mi.); Hurttig in the "Minister Leuschner" for 40 km (24.9 mi.); while Groenhoff and Hirth stayed with the front from the Rhön to the Elbe river. The path of the storm of July 25, 1931, is shown in Figure 15. At 5 o'clock the storm neared the Rhön, and 15 minutes later commenced the start at the Wasserkuppe. At 6 o'clock the storm front crossed the valley of the Werra, passed rapidly over the northern Thuringian Forest, but clung for a long time to the southern Thuringian Forest.

After 9 o'clock at night the storm gradually disappeared. Groenhoff and Hirth kept together in the van of the front as far as Erfurt, where they became separated, Hirth flew over Weimar-Apolda toward the valley of the Saale near Halle, where he landed after 8 o'clock at night at Schloss Friedeburg, having covered a distance of 175 km (108.7 mi.). Groenhoff left Erfurt for the northeast and landed at 9 o'clock at Meitzendorf, a suburb of Magdeburg, after covering a distance of 220 km (136.7 mi.).

The altitude-time curves of this flight are extremely illuminating. After his start from the Wasserkuppe, Groenhoff quickly reached an altitude of 500 m (1640 ft.), but just as quickly lost it again in the lee of the Wasserkuppe. The same thing happened on the Hohe Rhön. A gain on the windward side of this mountain massif is followed by an extraordinarily pronounced drop in the lee of the Hohe Rhön. This downwind zone, which apparently weakened the front considerably, also was the cause of the premature landing of several flyers. Hirth's altitude-time curve is very similar and likewise shows the effect of the terrain on the flight path. The two flyers did not reach the actual front until at the Geba, where both attained an enormous rate of climb. Groenhoff was carried from 900 m (2950 ft.) to 2500 m (8200 ft.) in incredibly short time, his rate of climb reaching 7.9 m/s (25.9 ft./sec.) at times. Hirth's altitude curve is identically the same, after having found the front a little later. For the next two hours

the altitude-time curve of both showed the same typical, uniform course of other front sailing flights. Groenhoff's subsequent lap over Querfurt toward the eastern foothills of the Harz was perfectly calm and devoid of any disturbances. Hirth, on the other hand, evidently encountered less propitious upwinds. After passing Arnstadt near Erfurt, he gradually but consistently lost altitude till he landed at Halle. Groenhoff's last hour was beset with unexpected difficulties. After losing 1000 m (3280 ft.) in height toward the end of the third hour, his course appeared extremely agitated. Evidently he encountered more turbulent air masses interspersed with strong downcurrents, which set up critical stresses in parts of his plane. Moreover, since it was quite dark after 9 o'clock and he did not feel justified in taking the risks involved in a storm flight in the dark, he effected a landing.

Groenhoff made two such flights in the same year, but rather than being easy victories, they were the results of a successful battle of human skill, endurance, and unshakable composure matched against the unrelenting powers of the elements, in a hailstorm over Munich and in storm squalls over Magdeburg, at times bordering on the limits of human endurance.

The enthusiasm with which the 12 flyers started for the storm flight is yet another forcible argument for the great value of engineless flight as part of a general flight-training schedule. And we are particularly justified in repeating a statement voiced over two years ago. Precisely the storm flight of July 25 proved our contention that "the present-day methods of sailing flight attracts a young generation which, instead of being apprehensive of an approaching storm, actually welcomes the arrival of the storm front and knows how to utilize its powerful energy. This generation of flyers accumulates a larger amount of special knowledge and experience than many an airplane pilot after years of flying practice."

Progress in sailing flight has been commendable, a fact, however, which in itself is no longer a surprise. It has been the same at every other Rhon contest. But it does prove the clear-sighted development of German sailing flight in the right direction. Sportsmanship of the pilot, scientific research, methodical training, large-scale expansion of flying activities toward one single purpose have aided in the retention of the unique position which German gliding activities command in the world of aeronautics.

And in this respect we wish to emphasize the performances of the three masters of sailing flight: Groenhoff, Kronfeld and Hirth, who have contributed much toward this world position.

Translation by J. Vanier,
National Advisory Committee
for Aeronautics.

TABLE I. DURATION AND ALTITUDE OF PRACTICE CONTEST

Entry	Glider	Pilot	Total time	Altitude 5 flights	Maximum duration 1 flight	Maximum height	Distance
		a) Junior Group					
			hr. min.	m	hr. min.	m	km
"Württembergischer Luftfahrt-Verein	Stuttgart	"Künzer	18 14		2 50	850	24.8
"Württembergischer Luftfahrt-Verein	Professor	Hakenjos	16 56	1765	2 49	750	29.8
Arbeitsgemeinschaft "für Segelfl. Würzburg	"Würzburger Gen.-Anzeiger	Schmidt Endres	14 55	-	8 59	-	-
Teichmann	Offermann	Teichmann	-	2082	2 20	680	34.6
Akaflieg Marcho-Silesia	Schlesien in Not	Pfeiffer	-	2080	2 34	855	-
Flinsch Ffm.	Francofurtia	Flinsch	-	-	2 52	-	-
Akaflieg Karlsruhe	Karlsruhe	v. Freydorf	-	-	2 38	700	-
		b) Advanced Group					
Badisch-Pfälz. Luftfahrt-Verein	Schriesheim	Bihlmeier	-	-	2 30	350	-

(km x .62137 = mi.) (m x 3.28083 = ft.)

TABLE II. DISTANCE AND ALTITUDE FLIGHTS OF PERFORMANCE CONTEST, 1931

Entry	Glider	Pilot	30 km (18.6 mi.) course	Maximum altitude	Landed at
			km	m	
Akaflieg Darmstadt	Darmstadt	Starck	31.3	580	Wenigentaft in der Rhön
" "	"	"	31.6	820	Wallroth bei Schlüchtern
H. Hemmer	Heil u. Sieg	Hemmer	32.5	400	Storkenhof b. Schlüchtern
Akaflieg Stuttgart	Württemberg	Rohm	38.0	510	Schwallungen
" "	"	"	42.1	260	Lengers bei Vacha
Hessenflieger-Verein für Luftfahrt	Minister Leuschner	Hurttig	40.3	250	Kieselbach bei Vacha
Württemberg. Luftfahrt-Verein	Lore	Bachem	40.4	520	Tiefenort
Luftfahrt-Verein Aachen	M.S.2	Mayer	54.5	475	Suhl in Thüringen
" " "	"	"	-	918	-
R. Kronfeld	Wien	Kronfeld	165	1020	Arnsberg
Segelflugschule Grunau	Musterle	Hirth	175	1720	Friedeberg b. Halle
" "	"	"	192.4	640	Brohl a.d. Mosel
G. Groenhoff	Fafnir	Groenhoff	107.4	1100	Laubach b. Friedeberg i.H.
"	"	"	220	2050	Meitzendorf b. Magdeburg

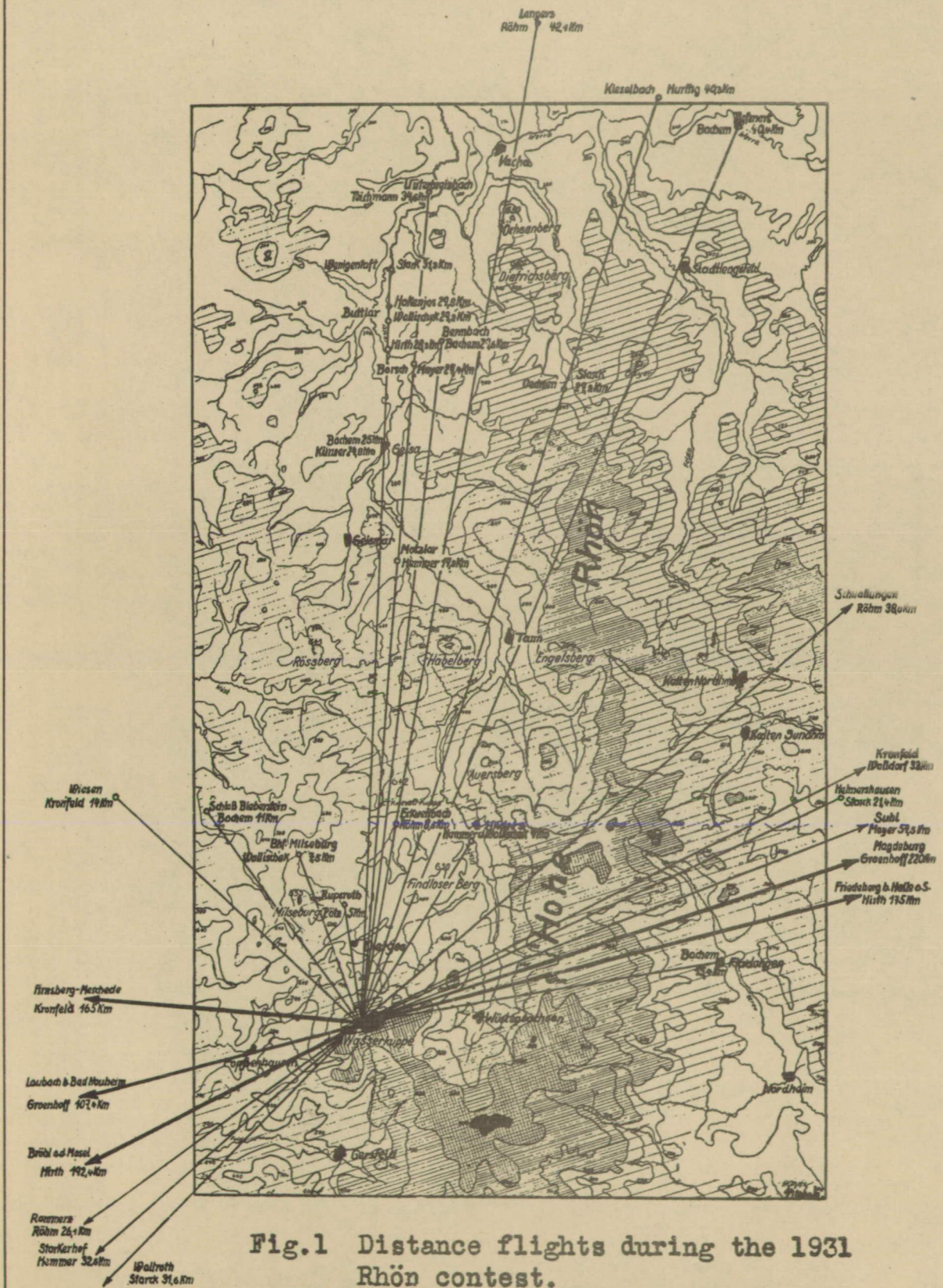


Fig.1 Distance flights during the 1931 Rhön contest.

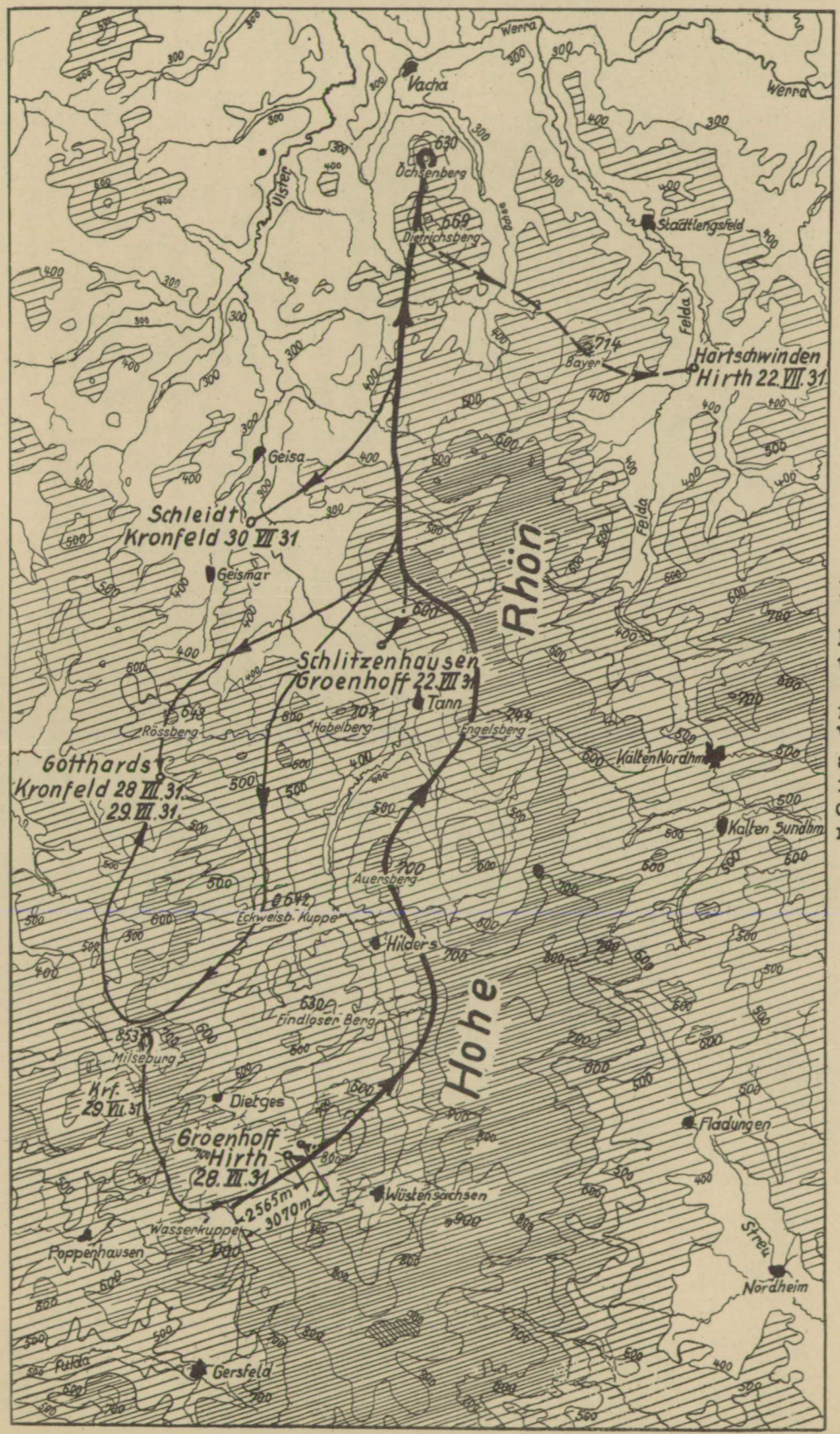


Fig.2

Flights with "Öchsenberg" near Vacha as fixed destination.

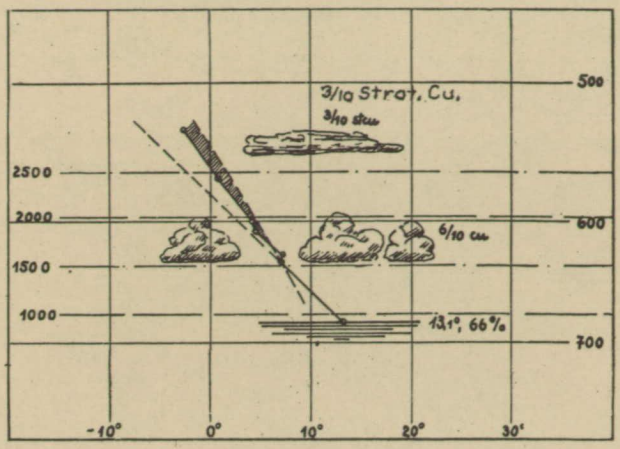


Fig.3
Emagram for
July 28,1931,
1^{50} P.M.
ascent
Wasserkuppe.

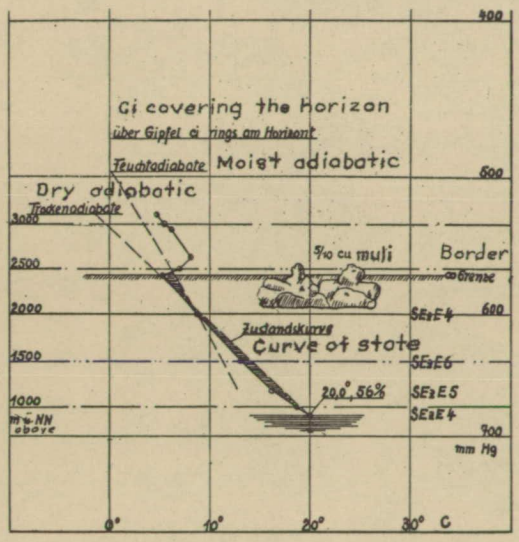


Fig.4
Emagram for
August 1,1931,
1^{40} P.M.
ascent
Wasserkuppe

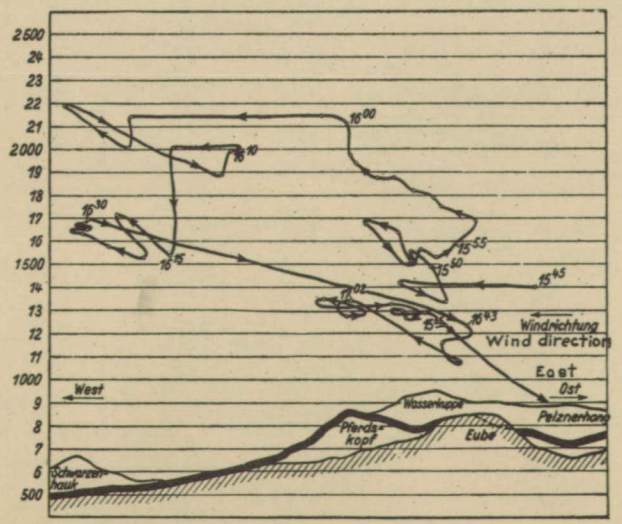


Fig.5
Route of
Hirth in
"Musterle",
Aug. 1,1931

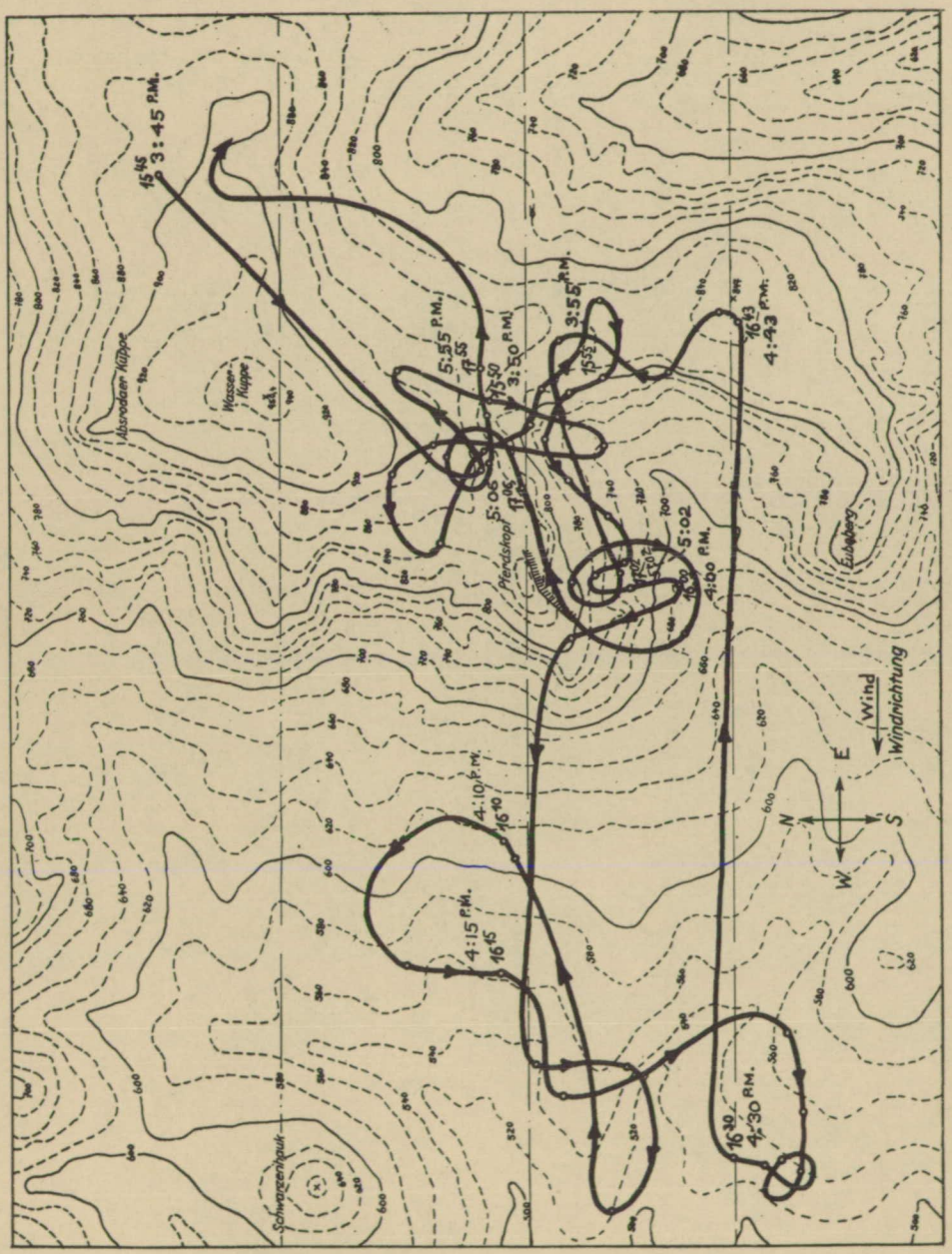


Fig.6 "Hirth in Musterle", Aug. 1, 1931 towed start, released at 1460 m (4800 ft.) scale 1:10000 . (Altitude 2 times).

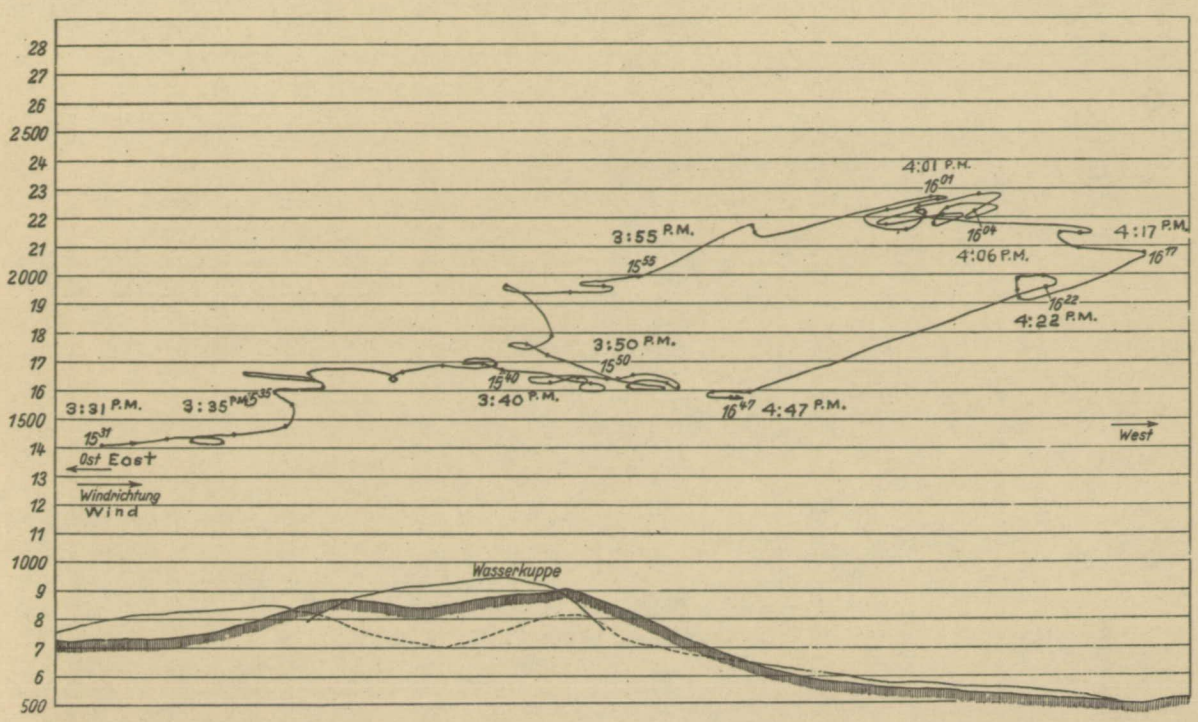


Fig.7 Groenhoff in Fafnir, afternoon of August 1, 1931.

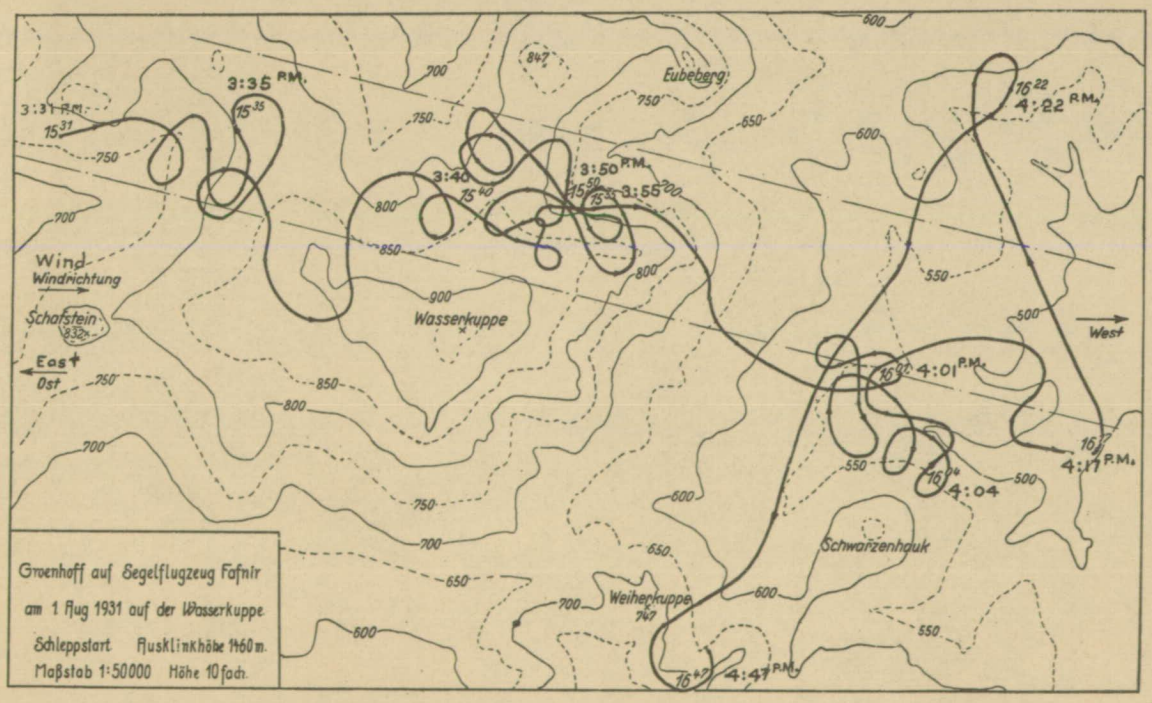


Fig.8 Groenhoff in Fafnir, afternoon of August 1, 1931, towed start, released at 1460 m(4800 ft.), scale 1:50000 (altitude 10 times).

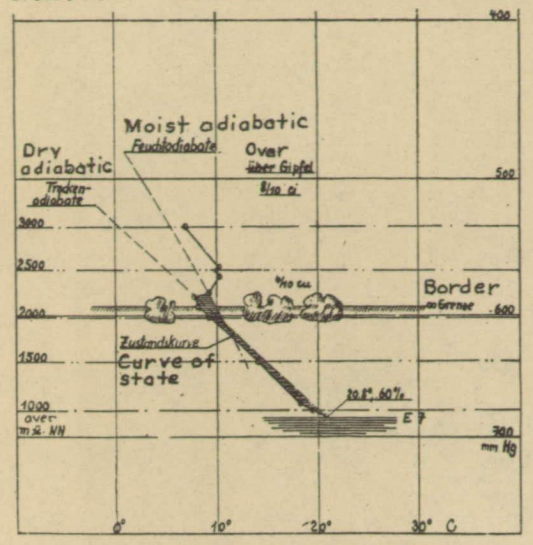


Fig.9 Emagram for Aug. 2,1931, ascent Wasserkuppe, 1^{40} P.M.

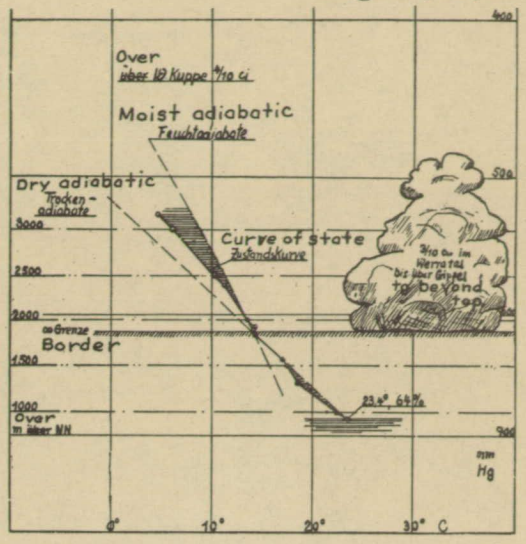


Fig.12 Emagram for August 5, 1931, start Wasserkuppe, 1^{55} P.M.

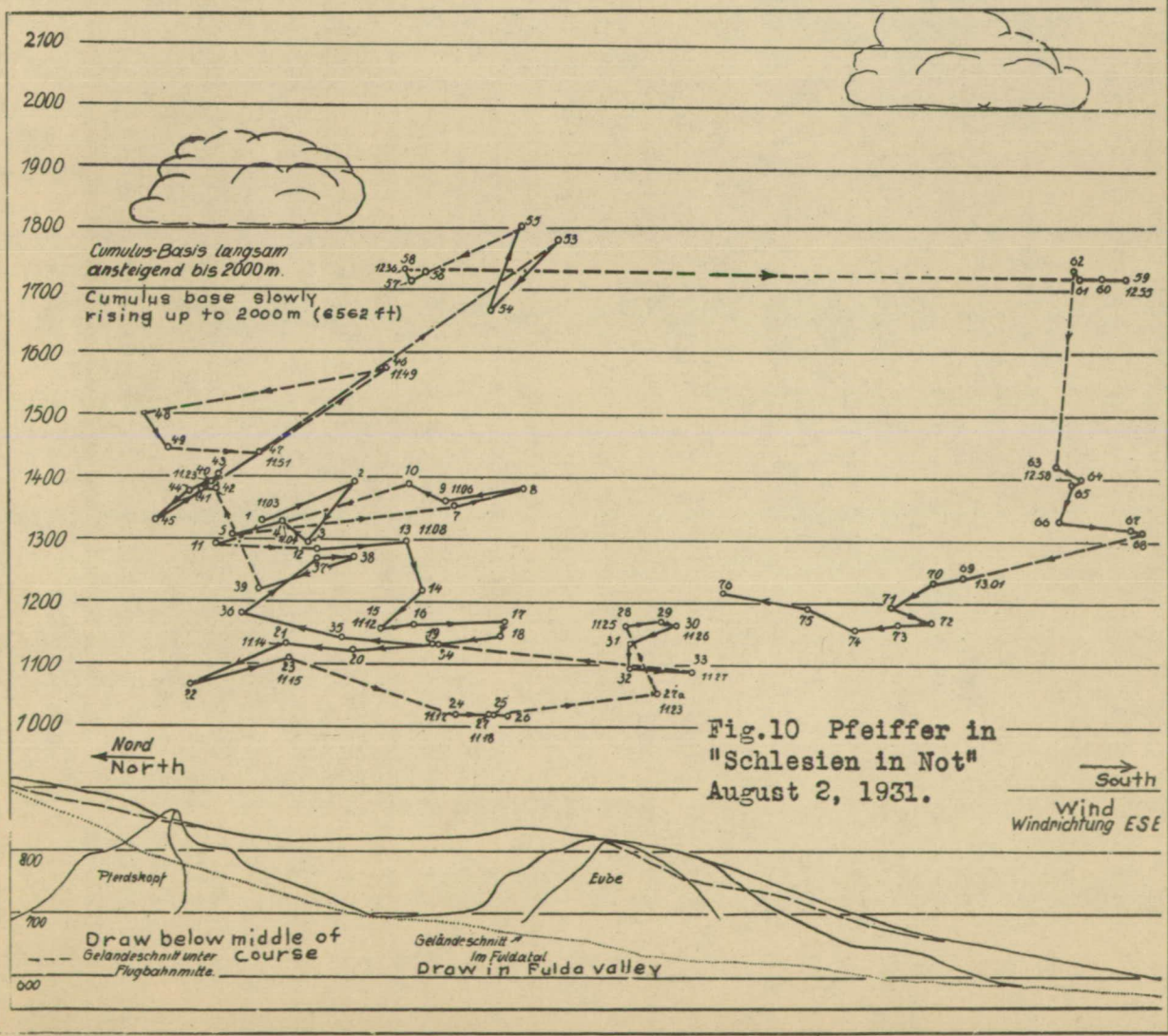


Fig.10 Pfeiffer in "Schlesien in Not" August 2, 1931.

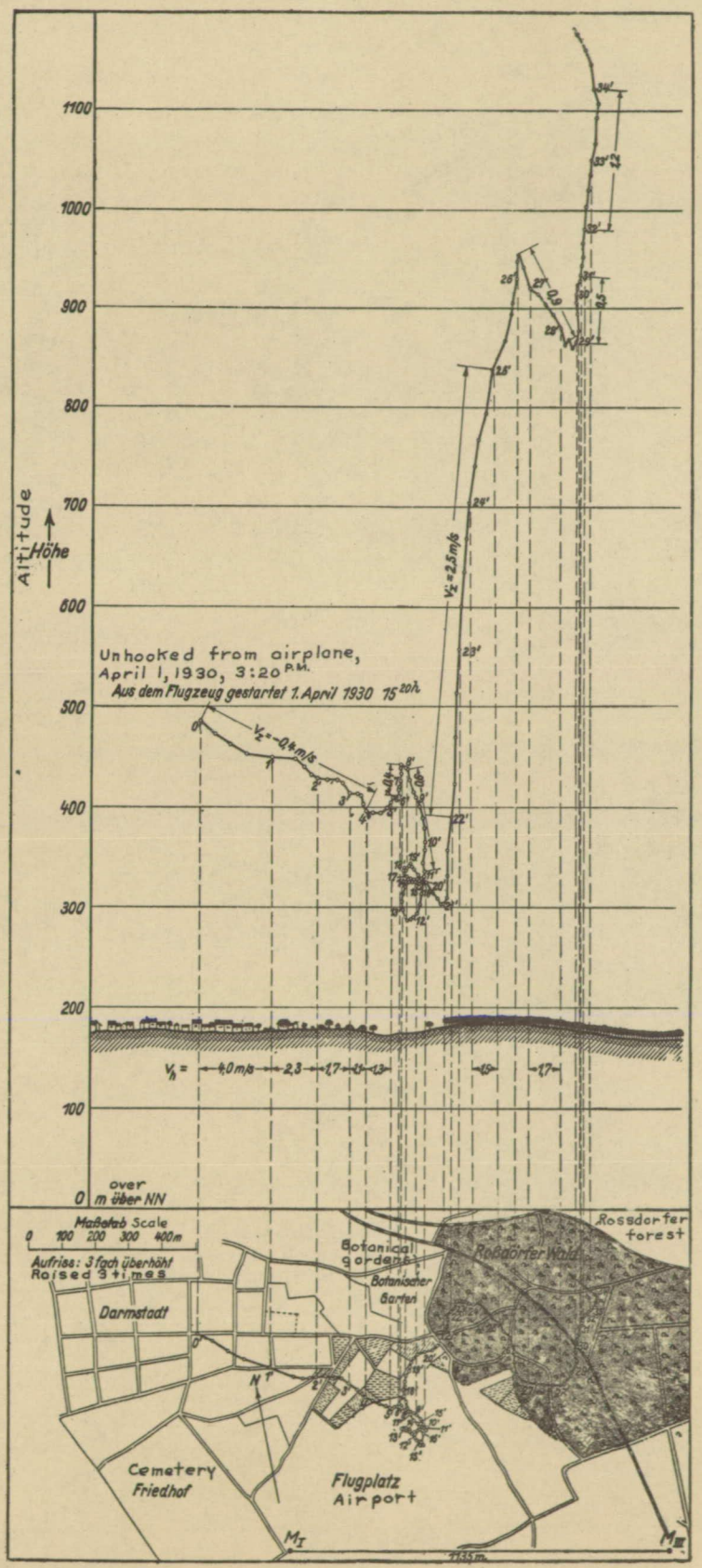
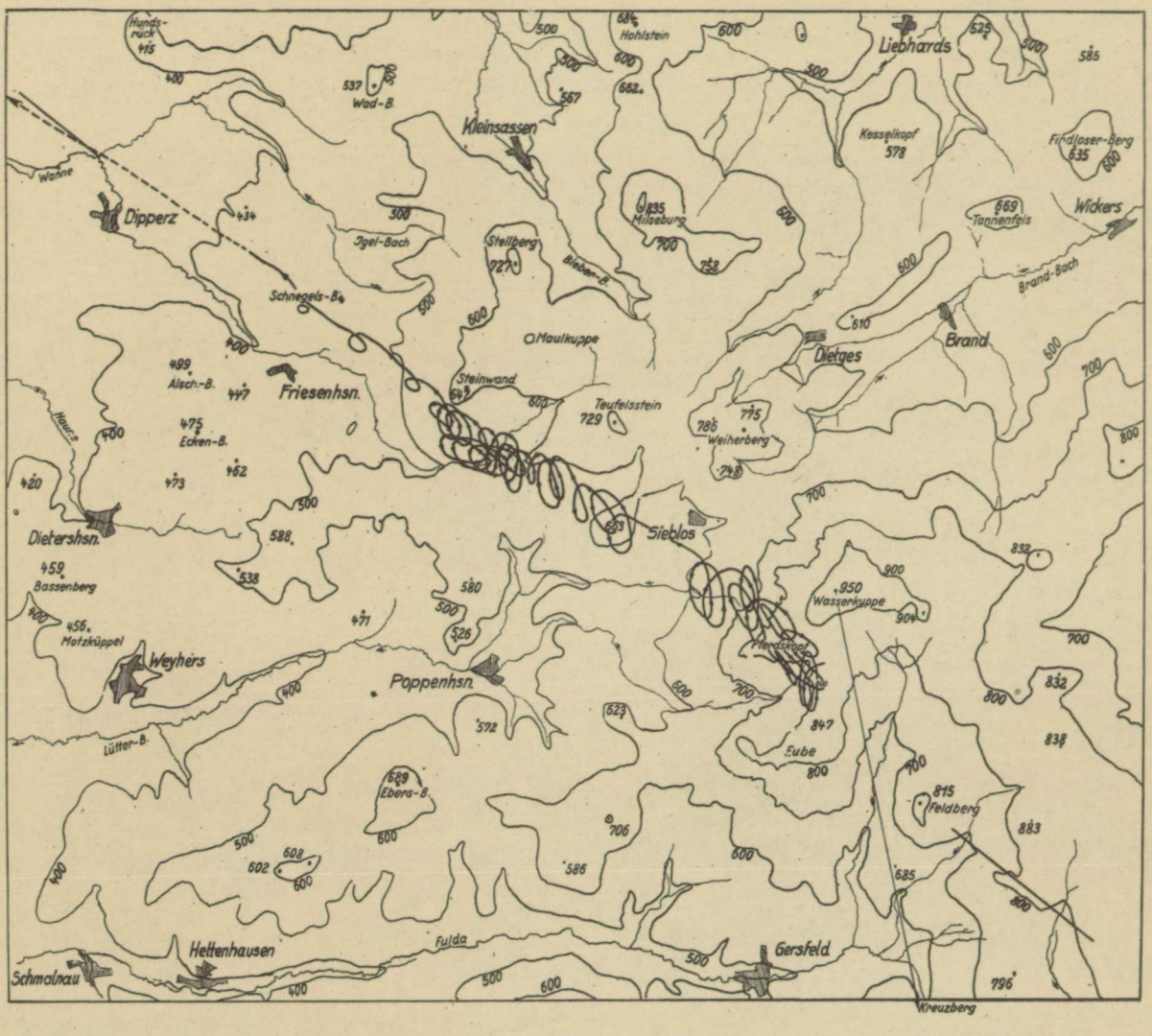

Altitude
Höhe
1100
1000
900
800
700
600
500
400
300
200
100
0
over
m über NN
Unhooked from airplane,
April 1, 1930, 3:20 P.M.
Aus dem Flugzeug gestartet 1. April 1930 15 20h
V_z = -0,4 m/s
V_z = +2,5 m/s
V_h =
4,0 m/s
2,3
1,7
1,3
1,5
1,7
Maßstab Scale
0 100 200 300 400m
Aufriss: 3 fach überhöht
Raised 3 times
Darmstadt
Botanical gardens
Botanischer Garten
Roßdörfer Wald
Rossdorfer forest
Cemetery
Friedhof
Flugplatz
Airport
M_I
M_{II}
1135 m

Fig.11



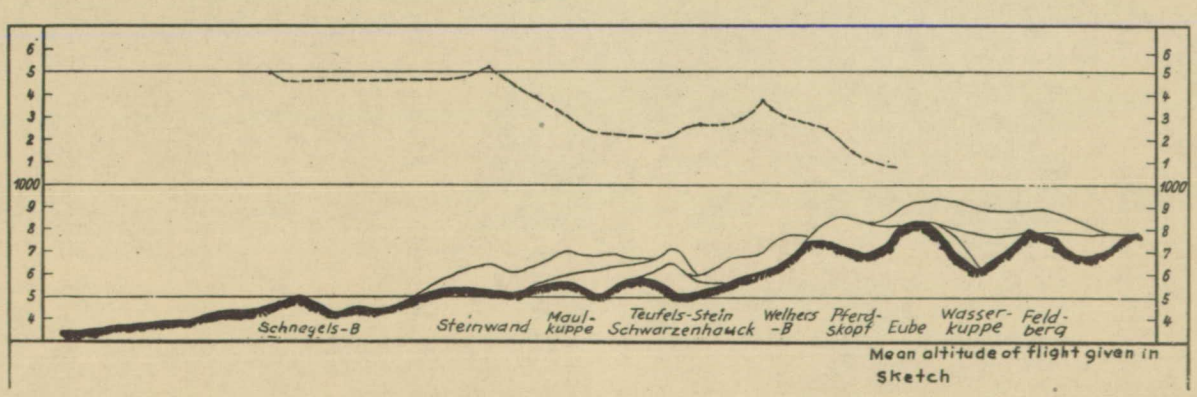


Fig.13 Plan and elevation of thermic sailing flight of Kronfeld in "Wien", August 5, 1931

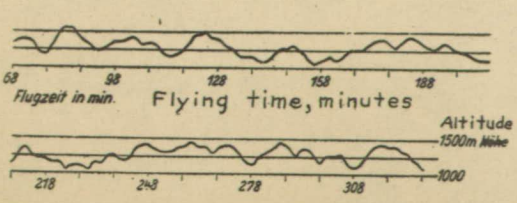


Fig.14 Barogram of Kronfeld flight, August 5, 1931.

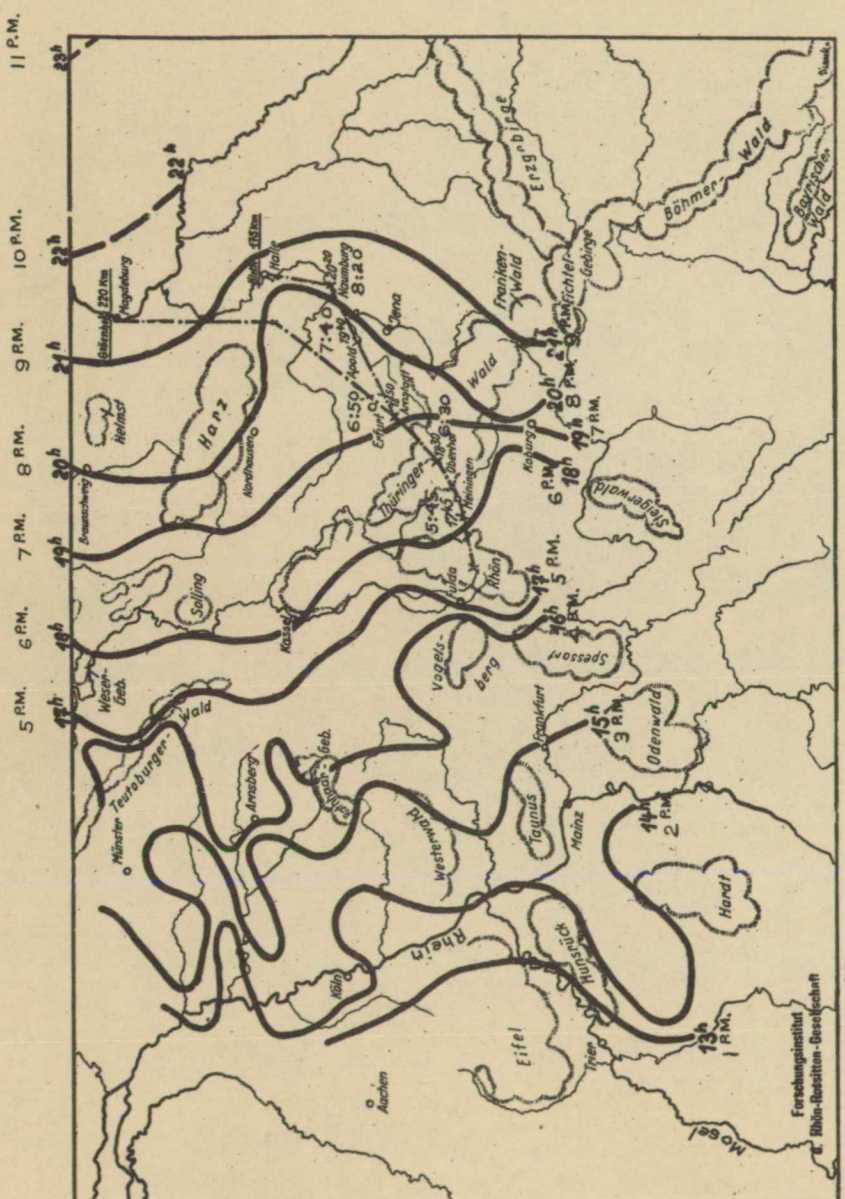


Fig.15 Track of storm front, afternoon July 25, 1931.

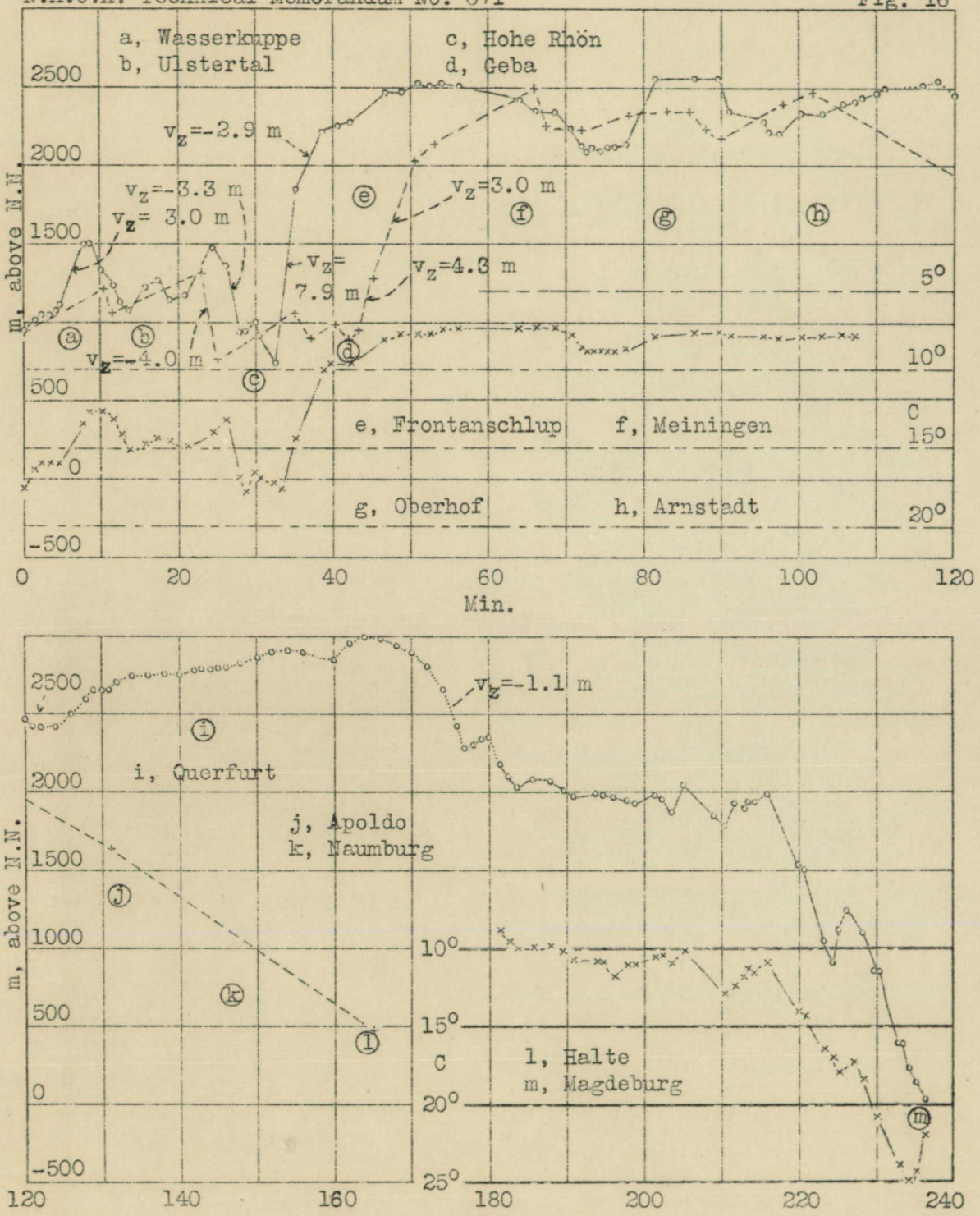


Fig. 16 Altitude-time curve of front flight by Groenhoff and Hirth. July 25, 1932. Start.- Wasserkuppe